RCSLT

Position paper: the role of speech and language therapists in awake craniotomy

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1. Summary and practice recommendations

1) The provision of specialist speech and language assessment during awake craniotomy is within the professional remit of speech and language therapists.

2) Speech and language therapists are experts in communication and offer specialist assessment, detection and interpretation of language network disruption. This contribution can lead to better functional outcomes, optimal tumour resection, reduced length of hospital stays and greater overall success of awake surgery.

3) Specialist speech and language therapy service provision is needed across the awake craniotomy patient pathway (pre-, intra- and post-operative stages). Workforce planning with organisations and commissioners is recommended to ensure an equitable and specialised speech and language therapy workforce is available to provide high-quality patient care.

4) SLTs working in awake craniotomy are part of a specialist neurosurgical multidisciplinary team. SLTs should work collaboratively with MDT colleagues at all stages of the surgical pathway.

5) Referral to speech and language therapy should be timely to enable a comprehensive pre-operative assessment for all patients. The assessment should involve: obtaining baseline speech and language skills; rapport building with the patient and family (if present); confirmation of patient suitability for awake craniotomy; and, crucially, ensuring the intra-operative testing paradigms correspond to the patient’s baseline function and cultural norms.

6) To ensure consistency of care, it is strongly recommended that the same clinician works with a patient across their pre-operative and inpatient pathway.

7) Speech and language therapists should keep up to date with evolving intra-operative language frameworks and assessments to ensure high quality care.

8) Testing materials should be patient-centred, culturally appropriate and tailored to the needs and background of the patient.

9) Multilingual patients, and non-English speaking patients, should be considered for testing of their primary and additional language(s) via an experienced interpreter. Factors such

as language proficiency, age of acquisition, patient goals and quality of life should be considered.

10) This publication is the first to articulate clinical practice expectations across the awake craniotomy pathway, outlining minimum theoretical knowledge and offers recommendations for skill acquisition.

11) SLTs are encouraged to actively advocate for the profession’s specialist role in awake craniotomy at local, national, and international levels. Ongoing engagement in influencing and campaigning efforts is essential to secure appropriate service funding and recognition.

12) As the role of SLTs in awake craniotomy is still emerging, further high-quality research is needed to strengthen the evidence base for their contribution. SLTs should also engage in local and national initiatives to shape service development and research agendas.

2. Introduction

This position paper outlines the role, value, and contribution of speech and language therapists within awake craniotomy services.

Its purpose is to provide clinicians with guidance on best clinical practice, informed by current evidence and expert consensus, and to support understanding of the SLT role in awake craniotomy for both practitioners and students.

The paper is intended for those advocating for, or developing, SLT service provision in awake craniotomy, including managers and commissioners. While the guidance is relevant to services across the UK, regional variations in resource availability and clinical practice should be considered. SLTs should apply this guidance in conjunction with local policy and procedures.

The paper should be read in conjunction with other relevant guidance from RCSLT, including guidance on aphasia, supported decision making and mental capacity, interpreters, bilingualism and augmentative and alternative communication (AAC).

3. Process

This position paper does not aim to provide a critical appraisal or systematic review of the literature; however, a review of the current evidence base was undertaken to ensure inclusion of relevant research to inform recommendations. The document was drafted by the lead author in collaboration with supporting authors and refined through expert input from multidisciplinary team colleagues. Co-production with a dedicated focus group of six individuals with lived experience of awake craniotomy was integral to the development process, ensuring the guidance reflects patient perspectives and is grounded in real-world practice. The draft underwent a comprehensive consultation process involving RCSLT members, neurosurgeons, neuropsychologists, and wider stakeholders (e.g. the Royal College of Anaesthetists and the Tessa Jowell Academy). All feedback received was reviewed systematically, with inclusion and rejection decisions within the scope of the project.

4. Context and evidence base

4.1 Clinical population

In the UK, more than 12,000 people are diagnosed with a primary brain tumour each year (The Brain Tumour Charity, 2025). A primary brain tumour refers to a tumour originating in the brain. A glioma is the most common type of primary brain tumour, corresponding to approximately 30% of primary brain tumours and 80% of malignant brain tumours (Goodenberger and Jenkins, 2012). In contrast, a secondary brain tumour is cancer that starts somewhere else in the body and spreads to the brain. It may also be called brain metastases. It is a type of advanced cancer (Macmillan Cancer Support, 2025).

The World Health Organisation (WHO) grades primary brain tumours from 1-4. Grade 1 and grade 2 tumours are low grade, benign and slow growing. Grade 1 tumours are unlikely to recur after treatment, whilst grade 2 tumours may recur after treatment and transform to a high-grade tumour depending on the tumour type. Grade 3 and grade 4 tumours are high-grade, fast growing and malignant (Macmillan Cancer Support, 2025).

Tumours which are close to, or within, a region of the brain responsible for speech or language function are termed 'eloquent'. Primary brain tumours within language eloquent cortical or sub-cortical areas of the brain have been associated with language impairment in 69% and 89% of low- and high-grade tumours, respectively (Brownsett et al, 2019). Surgical resection of brain tumour is a common treatment.

4.1.2 Additional clinical diagnosis

Primary brain tumours are the most common diagnosis requiring awake craniotomy treatment; therefore, the focus of this position paper is brain tumours. However, there is a growing body of evidence and clinical practice in the use of awake craniotomy for; cavernomas (Pamias-Portalatin et al 2018), aneurysms (Abdulrauf et al 2017), arteriovenous malformations (Tariq et al 2024), and deep brain stimulation (Vesper et al 2022), amongst others. Despite the different primary diagnoses, the SLT role and contribution in language assessment and preservation peri-operatively remain the same. Nuances in approach and clinical practice may occur with differing diagnosis. Therefore, close multi-disciplinary team communication and working is essential.

4.1.3 Awake craniotomy in the paediatric population

It is not in the scope of this paper to offer a full overview and recommendations for paediatric awake craniotomy. While the practice of awake craniotomy in the paediatric population is less common, there is a growing body of evidence about its feasibility, clinical indications and potential benefits (Al Fudhaili et al., 2023; Garcia-Tejedor et al., 2020; Barua et al 2024). It is recommended that SLT expertise should be sought in the process of paediatric patient selection, patient and family preparation and language assessment peri-operatively. Service planning in the neurosurgical paediatric population should include speech and language therapy service provision.

4.2 Awake craniotomy and brain mapping

Awake craniotomy is the resection of a brain tumour whilst the patient remains conscious and able to interact. It was first proposed in the 1950s for the surgical treatment of epilepsy. In subsequent decades awake craniotomy has become the gold standard practice for resection of eloquent brain tumours.

The aim of awake craniotomy is to locate and preserve function, while maximising safe tumour resection. The process of intra-operative 'brain mapping' involves the use of direct electrical stimulation (DES) to cortical or sub-cortical anatomy, which temporarily inhibits function for up to 4 seconds (Morshed, et al 2021; Papatzalas et al 2022). Cortical stimulation and patient responses are synchronised to create a personalised 'functional map'. The functional map will enable the neurosurgeon to identify and spare eloquent anatomy with the aim to reduce the incidence of post-operative speech and language deficits.

4.3 Direct electrical stimulation

For language mapping, direct electrical stimulation is typically administered via a bipolar stimulation, with the stimulation protocol being determined by the surgical team in theatre. A typical paradigm may consist of intensity starting at 2mAmps and is progressively increased by 0.5mA steps, until the current for evoking a brief after discharge potential is established. The current intensity just below this intensity is used for performing the mapping, at both cortical and subcortical levels. The current intensity usually ranges from 3.5 and 15mA, with an upper limit usually around 20mAmps. A contact electrode strip is inserted over the motor cortex to monitor electrocorticography and after discharge potentials (Seidel et al., 2022. Klitsinikos et al., 2021; Leon-Rojas et al., 2020).

In some institutions, neurophysiologists may be present to monitor discharge potentials and seizure activity. In other cases, a surgeon-led stimulator is employed, and they will be monitoring seizure activity clinically and/or electrically.

A sound or light may be used to indicate when the stimulation is being delivered. Alternatively, the surgeon may say “on/off”. This will be down to surgeon and team preference and should be established in pre-operative MDT planning.

4.4 Patient selection and suitability

Selecting suitable candidates for awake craniotomy requires careful consideration and is a critical factor in the success or failure of the procedure. Failed awake craniotomy is associated with sub-optimal tumour resection, increased neurological morbidity, a higher rate of major complications, and prolonged hospital stay (Fiore et al., 2022; Kram et al., 2024). Awake craniotomies require patients to perform speech and language tasks under the time constraints of cortical stimulation and transient language network disruption; therefore, sufficient baseline language skills to engage in this task are a prerequisite (Kram et al., 2024). A pre-operative speech and language assessment is essential to ensure appropriate patient selection and to reduce the incidence of failed awake craniotomy (O’Neill et al., 2020).

The process of determining patient suitability for awake craniotomy can be variable and often nuanced. Patient factors such as: lower age (<65 years); psychological resilience; baseline language eloquence are positive indicators for suitability. Meanwhile medical conditions such as cardiovascular disease, COPD, obstructive sleep apnea or obesity may contradict patient suitability (Burnand and Sebastian, 2014; Kram et al., 2024).

4.5 Anaesthetic techniques

Two primary anaesthetic techniques are widely recognised in awake craniotomy: the ‘asleep–awake–asleep’ (SAS), or often asleep-awake-sedated, approach and ‘monitored anaesthesia care’ (MAC). Both techniques rely on local anaesthetic scalp and incision blocks and both techniques have been proven to be safe with a low rate of failed procedures. There is no recognised consensus on the best anaesthetic approach, therefore surgeon preference, anaesthetist preference, underlying pathology, length of stay and patient factors contribute to determining which approach is used (Burnard and Sebastian, 2014).

The SAS approach begins with the induction of general anaesthesia (GA). Airway control is established via a supra-glottic airway device such as a laryngeal mask airway or iGel. The patient remains anaesthetised during the initial, more invasive phases - scalp block, head fixation, drilling and craniectomy (bone removal). Anaesthetic agents are then gradually reduced or discontinued at the point of dural opening to allow the patient to awaken for cortical mapping. Following tumour resection, GA is reintroduced, or alternatively light sedation is used, resulting in an 'asleep–awake–sedated' variation. This decision is made collaboratively by the anaesthetist and neurosurgeon and should also involve a discussion with the patient. (Natalini et al., 2020; Morshed et al., 2021).

A key advantage of the SAS technique is that it provides anaesthetists with greater control over ventilation, reducing the risk of hypoventilation and airway obstruction in the first phase of the operation. It also allows for a deeper level of anaesthesia during the most painful surgical stages. The main disadvantage to SAS is the potential risk of delirium on emergence which can lead to a failed awake craniotomy or a prolonged 'wake up' delaying the start of functional testing. Studies have shown the length of time it takes for patients to suitably wake from anaesthesia, to a level at which reliable functional testing can be started, varies from 5 minutes up to 39 minutes (Shen et al 2013., Leon-Rojas, 2020., Deras et al 2012).

By contrast, the MAC technique relies predominantly on local anaesthetic scalp nerve blocks and the careful titration of low-dose sedatives to maintain spontaneous ventilation while achieving an appropriate level of sedation. Its principal advantage lies in the ease with which sedation can be withdrawn, allowing for a rapid transition to a cooperative and responsive patient for functional mapping. The challenge with MAC lies in maintaining the balance of achieving sufficient sedation to manage pain and anxiety, while avoiding the risk of respiratory depression (Dziedzic et al., 2023, Min KT., 2025).

4.6 Intra-operative language assessment

A 2022 scoping review by Papatzalas et al. identified two main approaches to intra-operative language testing: (A) the use of validated, standardised language batteries, and (B) mixed batteries combining locally designed and borrowed tests, such as the Boston Naming Test (Kaplan et al., 1983).

Among validated frameworks, the Dutch Linguistic Intra-Operative Protocol (DuLIP) (De Witte et al., 2015) is one of the most influential internationally. DuLIP is a neurolinguistic battery comprising 17 tasks spanning phonology, semantics, syntax, and morphology, normed on 250 native Dutch speakers with pathological data from five brain tumour patients. It provides robust clinico-anatomical correlations grounded in direct electrical stimulation studies. Adaptations include a Portuguese version (Alves et al., 2021) and an updated model by Collée et al. (2023)

improving localisation validity. In the UK, speech and language therapists have adapted DuLIP's 'location-to-function' framework to develop local intra-operative testing protocols (Mariotti et al., 2025; O'Neill et al., 2020).

Other notable validated non-English speaking batteries include the Italian object and verb ECCO and VISC test (Rofes et al., 2015), the Russian Intra-operative Naming Test (Dragoy et al., 2016), and the Greek Linguistic Assessment for Awake Brain Surgery (GRAABS; Papatzalas et al., 2021). All account for intra-operative time constraints, with normed 4 second response times, and require pre-surgical patient training and stimulus selection.

The recent development of the British Object and Action Naming Test for Intraoperative Mapping (BOATIM) (Mumtaz et al., 2025) is the first standardised and clinically validated intra-operative language assessment tool designed specifically for British English-speaking patients. It comprises 115 object and 86 action stimuli tailored for functional mapping, and offers a locally relevant, evidence-based resource for SLTs and neurosurgical teams in the UK, complementing the international protocols such as DuLIP.

Additional multi-lingual protocols include the Verb and Noun Test for Peri-operative Testing (VAN-POP; Ohlerth et al., 2019), and the Multilingual picture naming test for mapping eloquent areas during awake surgeries (MULTIMAP; Gisbert- Muñoz et al., 2021). VAN-POP was developed for both navigated transcranial magnetic stimulation (nTMS) and DES contexts, using both noun and verb retrieval in sentence contexts. It is standardised for English, German, and Dutch speakers. Multimap consists of a database of 218 standardized colour pictures representing both objects and actions. These images have been tested for name agreement with speakers of Spanish, Basque, Catalan, Italian, French, English, German, Mandarin Chinese, and Arabic, and have been controlled for relevant linguistic features in cross-language combinations.

As the field continues to evolve, further language frameworks are emerging; such as from Marino et al's., 2024 systematic review, which offers a comprehensive map of the principle white matter (sub-cortical) language tracts, describing their most employed tests and the expected responses; or from Voet et al's 2025 consensus recommendations from clinical functional MRI (fMRI) and language mapping, which offers a comprehensive overview of cortical regions, their associated language process and predicted consequence with damage.

Speech and language therapists should remain up to date with the evolving intra-operative language frameworks and assessments available to ensure the delivery high quality patient care.

For more information on intra-operative language frameworks and assessments, see RCSLT awake craniotomy members' page.

5. The need for speech and language therapy service provision

5.1 Workforce contribution

The role of speech and language therapists in awake craniotomy is multifaceted, specialised, and continually evolving. SLTs possess the expertise to provide dynamic and targeted language assessment across the patient pathway, encompassing pre-, intra-, and post-operative phases. Their contribution can optimise language and neurological outcomes, enable greater extent of tumour resection, and an overall shorter hospital stays.

Focus group feedback emphasised the SLT's critical role in preparing patients and families for the awake craniotomy process and in setting realistic expectations. Participants highlighted SLT expertise, confidence, and experience in language assessment and management, helped alleviate their anxiety and prepare them for potential transient post-operative difficulties.

Pre-operative activities include aligning patient testing paradigms with baseline function and, where necessary, training interpreters to support effective communication. During surgery, SLTs administer targeted language assessments while monitoring speech and language networks in real time. They interpret language disruptions and communicate findings immediately to the neurosurgeon, thereby helping to minimise the risk of permanent language deficits. SLTs also act as patient advocates within the surgical team, alerting the anaesthetist to any discomfort or fatigue and supporting overall patient well-being.

Following surgery, SLTs provide holistic support to patients and families if communication difficulties arise, delivering bespoke therapeutic interventions, strategies and guidance. They facilitate a safe transition from hospital to home, which may include referral to additional services to ensure ongoing support.

The Tessa Jowell Brain Cancer Mission 2023 Centre of Excellence report lists "speech and language therapy clinic in awake craniotomy" as an exemplar in their 'Library of Excellence'. The report highlights the value of allied health professional–led clinics in neuro-oncology in the optimisation of patient quality of life.

Integration of SLTs within the multidisciplinary team, as highlighted by both focus group feedback and the TJBCM report, represents a model of best practice for delivering high-quality, patient-centred care.

5.2 National guidelines

The National Institute of Clinical Excellence (NICE) guidelines for brain tumours (primary) and brain metastases in over 16s (2021), recommends that awake craniotomy should be considered for people with low- and high-grade tumours to preserve neurological function. The guidelines advise to "involve other specialists as appropriate, such as neuropsychologists and speech and language therapists, before, during and after awake craniotomy."

5.3 Service planning

A 2020 online survey of SLT practice, found an average overall clinical time spent with an individual patient is approximately 10.5 hours (O'Neill, et al). However, this number does not reflect the overall scope and breadth of the SLT role within an awake craniotomy service, such as:

- SLT workforce training, supervision and shadowing
- continual professional development
- attendance at weekly multi-disciplinary meetings
- attendance at pre or post operative multi/uni-disciplinary clinics
- MDT training
- service audit and improvement
- attendance and contribution to local, national and international conferences or training forums
- conducting and engaging in research

The precise number of SLTs working in awake craniotomy is unknown (O'Neill et at, 2020). However, data collected through the Tessa Jowell Centre of Excellence for Adults programme (TJBCM, 2024) found that most UK neuro-oncology centres involve SLT in the awake craniotomy pathway (73%, 16/22 centres). However, over half of these centres (7 centres, 56%) indicated that SLTs had no dedicated time allocated for awake craniotomies, with support often provided on a goodwill basis. This means that the level of support provided at each centre (pre-, peri- and post-operative) varies, even among those services with access to SLT.

Currently there are various models of service which exist for the SLT workforce in awake craniotomy, which may result in risk to high quality, responsive and reliable SLT service, as demonstrated in table 1.

Funded SLT service provision embedded in awake craniotomy services	**Unfunded SLT service provision**
Dedicated and ring-fenced awake craniotomy time to establish and maintain a responsive, engaged and equitable service.	Ad-hoc service delivery which is unfunded, and time taken from other clinical areas of

	SLT provision. Service is not guaranteed and inequitable due to high clinical demands.
SLT is embedded as a core member of the MDT awake craniotomy team, enabling opportunities to build working relationships, establish role and attend MDT meetings or clinics.	SLT role under-recognised and under-valued. Limited opportunity to engage in regular MDT meetings or clinics due to other caseload demands.
Dedicated time to engage in SLT training and clinical development, ensuring a confident and highly skilled workforce.	Under-resourced service resulting in reduced training opportunities, leading to reduced workforce confidence and competence.
Dedicated time for service improvement, audit and contribution to research. Ensuring practice is innovative and high quality.	Limited resources or time available to evaluate and improve service provision.

Table 1. The risks versus benefits of different models of service provision.

Workforce planning with organisations, commissioners and service managers is recommended to ensure an equitable and specialised speech and language therapy workforce is available to provide high-quality service-level and patient care.

6. Multidisciplinary team working

MDT working is an integral role of SLTs in awake craniotomy. SLTs work collaboratively with MDT members across the patient pathway. Where services have an established brain mapping MDT (BM-MDT) meeting, the presence and active contribution of SLTs should be strongly encouraged. Klitsinikos and colleagues (2021) highlight the expertise and value of SLTs within their local BM-MDT, particularly in relation to developing mapping paradigms for the supplementary motor area (SMA) in accordance with MDT consensus.

The awake craniotomy MDT may include:

- neurosurgeons
- neuropsychologists
- neuroanaesthetists
- neurologists
- clinical nurse specialists
- neuroradiographers
- neurosurgical nurses
- operating department practitioners
- neurophysiologists
- neuroradiologists
- physiotherapists
- orthoptists
- occupational therapists

TJBCM (2024) data collected through the Tessa Jowell Centre of Excellence for Adults programme found that SLTs are involved in awake craniotomy in 73% of neuro-oncology centres. Physiotherapy and occupational therapy are involved in 45% and 23%, respectively. Beyond allied health professionals, neuropsychologists and neurophysiologists supported awake craniotomies in 73% and 41% of centres, respectively.

7. Clinical management

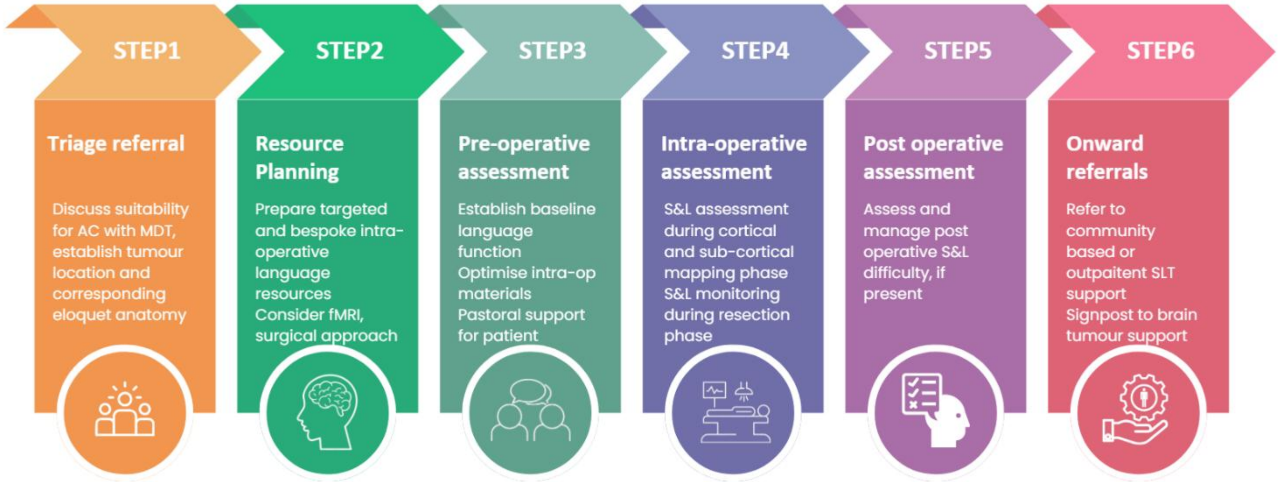

Figure 1. Schematic representation of SLT role and contribution peri-operatively

7.1. Pre-operative planning and functional neuro-imaging

While tumour location can be a predictive factor for aphasia, there is individual variability as well as tumour-induced functional reorganisation (Ille et al, 2019). Pre-surgical functional neuroimaging is warranted to identify language activation.

7.1.1. Functional magnetic resonance imaging (fMRI)

Functional magnetic resonance imaging (fMRI) is a non-invasive neuroimaging technique widely utilised for pre-surgical risk assessment and planning. During fMRI, patients engage in language tasks - such as verb generation or object naming - allowing clinicians to identify the associated neuroanatomical activations and, importantly, assess their proximity to tumour margins and the potential risk of functional disruption.

SLTs should be aware that the tasks used during fMRI may differ from those employed intra-operatively. This distinction is critical, as task-specific neural activation patterns may vary, and intra-operative testing must be tailored to the patient's pre-operative language profile and surgical context. Where possible, collaborative working with the neuro-radiologists is recommended.

In addition to localising language networks, fMRI plays a key role in determining hemispheric dominance for language. The resulting activation maps are valuable tools for neurosurgeons, and speech and language therapists, aiding in the planning of intra-operative mapping strategies and informing surgical trajectories that minimise the risk of damage to eloquent cortical areas (Voets et al., 2025; Connelly et al., 2022).

7.1.2 Navigated transcranial magnetic stimulation (nTMS)

Navigated transcranial magnetic stimulation (nTMS) is a non-invasive technique that delivers focal magnetic pulses through the skull to the left cerebral cortex, whilst a patient engages in a language task. This method allows for the temporary disruption of cortical activity, helping to identify regions involved in language processing and generate a functional language map, pre-operatively.

While nTMS has demonstrated high sensitivity in detecting language-related areas, its specificity remains comparatively lower. Nevertheless, one of its key advantages lies in its ability to produce a ‘negative map’ - effectively ruling out areas unlikely to be critical for language function, thereby refining the focus of intra-operative mapping (Lehtinen et al., 2018).

7.1.4 Diffusion tensor imaging (DTI)

Diffusion tensor imaging (DTI) tractography is an advanced MRI technique used to visualise the probable location and trajectory of sub-cortical white matter language tracts. In the context of neurosurgical planning, DTI is particularly valuable for identifying the relationship between key language pathways and the tumour site (Shalan et al., 2021).

Crucial subcortical language tracts that may be visualised include the superior longitudinal fasciculus (SLF), inferior fronto-occipital fasciculus (IFOF), arcuate fasciculus (AF), uncinate fasciculus (UF), frontal aslant tract (FAT), and the cortico-spinal tract (CST). Understanding the proximity of these tracts to tumour margins helps inform surgical strategy, aiming to preserve language function while achieving maximal safe resection.

7.1.5 Formulation of intra-operative language testing

SLTs should incorporate all available pre-surgical findings, to inform the development of tailored intra-operative language testing paradigms. These findings may include:

- structural MRI findings
- functional MRI (fMRI) activation maps
- diffusion tensor imaging (DTI) tractography
- navigated transcranial magnetic stimulation (nTMS) results
- neuropsychological assessment outcomes

- patient case history and symptom profile
- collaborative discussion with the neurosurgical team, specifically to identify cortical and subcortical regions at risk, including those along the planned surgical trajectory

With the combined findings of available sources, SLTs can reference established anatomo-functional frameworks—such as the DuLIP model—to design a patient-specific, functionally relevant intra-operative assessment.

7.2 Pre-operative assessment

7. 2.1 Referral, timings and aims of assessment

The pre-operative speech and language therapy assessment is a vital component of the awake craniotomy pathway and should be conducted for all patients undergoing this procedure (O'Neill et al., 2020; Trimble et al., 2015; Papatzalas, 2022; De Witte et al., 2015). Early and timely referral to SLT is strongly recommended to allow adequate time for comprehensive assessment, planning, and collaboration with the wider multidisciplinary team.

Pre-operative assessments may be conducted in an outpatient setting or during an inpatient admission in the days or weeks leading up to surgery. SLTs must carefully consider the timing of the assessment in relation to the nature and progression of the tumour. In cases involving high-grade or rapidly growing tumours, it is preferable to complete the assessment as close to the surgical date as possible to ensure an accurate reflection of the patient's current language function and minimise the impact of tumour progression on planning.

The pre-operative SLT assessment should aim to achieve the following:

- Evaluate the patient's suitability for awake craniotomy in the context of their baseline speech and language function.
- Consider psychological resilience and liaise closely with neuropsychology colleagues if concerns regarding emotional readiness or cognitive capacity arise.
- Conduct a comprehensive baseline evaluation of the patient's speech, language, and communication skills to inform intra-operative testing and post-operative comparisons.
- Deliver pre-operative education and preparation to the patient and family or support network. This should include realistic discussions about potential speech and language changes that may occur during or after surgery. For example, patients whose supplementary motor area (SMA) is at risk should be educated about the possibility of SMA syndrome and its clinical implications.

- Establish rapport and familiarity, identifying the patient's preferred conversation topics to support dynamic, personalised conversational analysis during resection.
- Practise intra-operative language tasks, with particular emphasis on excluding items that elicit incorrect or delayed responses. This ensures the intra-operative test set is optimally representative of the patient's language function.

This process should be replicated for patients undergoing repeat awake craniotomies. Language function may change between surgeries, and revisiting the assessment allows for updated planning and meaningful re-education. Patients also report valuing the time spent preparing for the procedure, regardless of their prior experience.

7. 2.2 Pre-operative counselling and pastoral role

A recent systematic review by Mofatteh et al (2023) concluded that an awake craniotomy does not increase psychological symptoms like stress, anxiety or depression. Nevertheless, it is important for SLTs to spend time preparing the patient and explaining the process of mapping and language assessment. Often patients have a fear of pain, so informing them that the brain does not have pain receptors, and they will be unable to feel the tumour resection, can be helpful to relieve concern. Information regarding potential or expected intra-operative language disruption, post-operative language deficits, speech and language therapy interventions and course of recovery should be offered to the patient and family.

7.2.3 Rapport building and person-centred approach

The pre-operative speech and language therapy assessment offers an excellent opportunity to establish a rapport with the patient and enable trust and familiarity. The SLT should ensure a trusting relationship is established as they are the professional primarily interacting with the awake patient. Conversation is often used during the resection phase of the surgery to continuously monitor dynamic language and offer the patient a break from formal testing. Understanding the patient's interests and preferred topics of conversation will enable a more person-centred approach.

7.2.4 Practice of intra-operative language tests

Practice of the intra-operative language tests is paramount to the success of the awake craniotomy. The SLT should ensure that the patient is able to perform the tasks seamlessly and within a 3-4 second timeframe. If errors are made, or there is a delayed response time of more than 3 seconds, the stimuli should be removed from the intra-operative language battery. This will allow the SLT to be confident that errors elicited during brain mapping are secondary to DES, and not a baseline aphasia associated with the presence of the brain tumour (Papatzalas, 2022).

Practice of the intra-operative language assessments can also help prepare the patient for surgery and set clear expectations.

Where possible, culturally and linguistically relevant test items should be used in peri-operative language testing, as concept misinterpretations (e.g. in picture naming) can have a major detrimental impact on evaluations (Mumtaz, et al., 2025).

7.2.5 Further communication assessment

SLTs should use their clinical experience and knowledge to determine if further formal language and/or cognitive communication assessment is required, e.g. Comprehensive Aphasia Test (Howard and Patterson 1992) or Measure of Cognitive Linguistics (Ellmo, 1995) in addition to the dynamic conversational analysis, practice of intra-operative language tasks, and neuropsychology report and findings from fMRI, nTMS and DTI (if available).

7.2.6 Patient eligibility

SLTs have an excellent understanding of the demands placed upon a patient intra-operatively. These include a quick speed of auditory or reading processing (3-4 seconds), adequate baseline communication skills and an appropriate level of psychological resilience. Throughout the pre-operative assessment, SLTs should consider these demands in relation to eligibility. For example, Mariotti et al (2025), found in their survey of clinical practice that 97.2% of clinicians agree that patients need to have at least sentence-length communication to be eligible for awake craniotomy. Those patients who are non-verbal were deemed unsuitable by all survey respondents.

If there are concerns about a patient's eligibility, these should be discussed with the neurosurgeon, neuropsychologist and appropriate MDT members as soon as possible. Attempts should be made to support patient eligibility, where possible, e.g. clinicians should attempt to match the intra-operative testing stimuli to the patient's baseline communication capabilities, or in the case of anxious patients, theatre familiarisation visits should be considered.

7.3 Intra-operative assessment

7.3.1 Anaesthetic technique

The SLT should have knowledge of the anaesthetic technique to be undertaken for each awake craniotomy procedure as this will help to inform how quickly reliable functional testing can be commenced. In addition, it is important to know whether iatrogenic or pharmacological issues may be impacting on the patient's cognition and neurological capacity. They should be aware of the potential benefits and complications to a SAS versus MAC technique.

In all cases, the SLT should practise a sample of the language tests with the patient, prior to the commencement of mapping to confirm adequate patient performance and reliability of responses. If the patient is performing at a sub-optimal standard and off their pre-operative language baseline, the SLT should alert the neurosurgeon and anaesthetist immediately. The patient may benefit from waiting for a longer period for the effects of the anaesthesia to wear off, or the anaesthetist may have to reduce sedatives further. In the event that no sedative drugs are being used, it is important to ensure the surgeon is aware of the neurological deficit as there may be an intracranial cause, including sub-clinical seizure activity.

If after a period of appropriate time the patient remains at a sub-optimal performance level, i.e. they continue to make errors which are unrelated to mapping, and both drug related and non-drug related causes have been excluded, then a new baseline language sample of relevant tasks should be taken prior to the introduction of DES. The commencement of DES and mapping should be discussed between the SLT, neurosurgeon, anaesthetist and, where possible, the patient.

7.3.2 Surgical approach

SLTs should be familiar with the neurosurgeon's planned resection approach, particularly in cases of deep-seated tumours where removal of healthy cortex is required to access the tumour bulk. When multiple entry routes are possible, language assessments should be prepared for each eloquent area identified in consultation with the neurosurgeon.

7.3.3 Mapping phase

The intra-operative SLT role is dynamic and multi-faceted, consisting of:

- conducting speech and language testing during both mapping and resection stage
- constantly communicating with the patient
- providing calming reassurance throughout
- identifying and interpreting speech and language errors
- communicating errors effectively and succinctly to the neurosurgeon
- monitoring for overt complications, such as seizure activity
- keeping a record of error types and their corresponding neuro-anatomy. However, it is recommended that the role of intra-operative data collection is negotiated amongst the MDT, as balancing live record-keeping, alongside patient assessment can be challenging.

Prior to the commencement of mapping SLTs should ensure the patient can see the testing material adequately. If the patient wears glasses or hearing aids, these must be available intra-operatively.

Communication with the neurosurgeon is paramount in the mapping phase of the surgery. Agreement on how to communicate patient errors should be established with the neurosurgeon prior to commencement of mapping.

SLT knowledge of language eloquent functional boundaries is crucial to the selection of suitable language assessment in surgery. As the surgery progresses, SLTs should change the language tasks to correlate with the anatomical areas the neurosurgeon is mapping or resecting.

SLTs should present the language tests in synchrony with the DES. It is important the SLT does not present the stimuli prior to the cortex being stimulated; this may result in an unreliable map as the patient has been able to see or hear the language task and formulate a response prior to the stimulation-inducted language network disruption. To achieve this, SLTs should be aware of local indicators for when the cortex is being stimulated, e.g. through beeping noise, or the neurosurgeon saying "on/off".

7.3.4 Intra-operative language network disruption

SLTs should recognise and interpret language network disruption and communicate this to the neurosurgeon immediately. Possible language disruption features are:

- hesitancy or delay in response (to an otherwise immediate response at baseline)
- phonological paraphasia
- semantic paraphasia
- speech arrest
- dysarthria
- dysfluency or stammer/phonological repetition or prolongation
- facial droop or twitching on the contralateral side of neurology
- anomia
- alexia
- auditory comprehension errors
- syntactic or grammatical errors
- agraphia

SLTs should provide ongoing reassurance to the patient throughout mapping, especially if temporary language disruptions occur. Such disruptions should be framed positively, as they help identify and preserve eloquent anatomy.

For infection control, all language tests should be presented electronically on a single, wipe-clean device before and after use. The only exception is writing assessment, which may use pen and paper.

7.3.5. Intra-operative seizures

SLTs should be aware that intra-operative seizures can occur. A systematic review found the incidence of intra-operative seizures to be approximately 8.4%. Patients with a history of seizures, lesions in the frontal or temporal lobe and patients taking anti-epileptic medications are at a higher risk of intra-operative seizures (Shakir et al 2023). The literature suggests a correlation between cortical stimulation and seizures. SLTs should be aware of the need for repeated cortical stimulation during the gradual increase of DES mAmps.

Seizures often present initially as focal activity and, if identified early and treated effectively before propagating to a tonic-clonic seizure, will often have a minimal post-ictal period meaning functional testing can proceed with little interruption. It is imperative that SLT maintain visual contact with the patient to identify facial seizures and in collaboration with the physiotherapy (if present) team to identify limb seizures quickly. A clear history of the nature of the patient's seizures before surgery can help with identifying any prodrome or aura that may be an early indication of impending seizures.

If seizure activity is evident, SLTs should cease testing and alert the surgical and anaesthetic team immediately. Cortical cooling through the topical application of cooled saline has proven effective at reducing seizure activity intra-operatively (Ibayashi et al, 2021). When successful, cortical cooling can prevent propagation of the seizure and functional testing may be able to proceed very quickly. Recommencement of mapping and language testing should occur if the patient is able to appropriately interact with the team and a reliable sample can be obtained from the patient.

In some instances, cortical cooling may be unsuccessful and close collaboration with the anaesthetic team is essential to identify and manage this. Incremental doses of propofol, small doses of benzodiazepines (midazolam) or, in severe cases, fully re-anaesthetising the patient may be needed. In this case, further functional testing may be possible once the patient has recovered from their post-ictal phase and the sedation, but this is not always the case, and a further functional baseline may need to be assessed.

7.3.6. Resection phase

During the resection phase, SLTs can monitor language function without the strict time constraints associated with mapping. This monitoring can be dynamic, incorporating both conversational interaction and language assessment.

Spontaneous speech is a complex process, relying on the integration of multiple linguistic domains - semantics, phonology, morpho-syntax, and articulation. Using spontaneous speech during the resection phase enables SLTs to observe a broad range of linguistic functions, while also helping to identify areas that may require targeted testing (Collée et al., 2023). For instance, if a patient produces a phonological error in conversation, this may prompt more focused assessment of the phonological network. For this reason, SLTs should prepare patient-preferred conversational topics in advance.

The SLT, neurosurgeon, and neuro-anaesthetist should work together to balance ongoing language monitoring with the preservation of patient energy, particularly in longer surgeries. The resection phase can also provide an appropriate opportunity for short breaks from testing and speaking to minimise fatigue, thereby maintaining the validity of subsequent assessments.

7.3.7 Clinical Documentation and Intra-operative Data Collection

Clinical documentation should align with RCSLT guidance, HCPC standards of proficiency, and local institutional policies to ensure consistency, transparency, and accountability across the care pathway.

Peri-operative data collection is encouraged to support service evaluation, clinical audit, and contribution to research and quality improvement initiatives. Areas of data collection may include patient-related outcome measures (PROMs), patient and staff experience, and procedural metrics relevant to the awake craniotomy pathway.

However, the complex and fast-paced nature of intra-operative SLT work presents challenges to real-time data capture. As such, it is recommended that the MDT reach a clear consensus on the purpose, content, timing, and responsible party for intra-operative data collection. This shared understanding ensures consistency in documentation, supports reflective practice, and enhances the quality of both clinical care and research outputs.

7.4 Post-operative assessment

7.4.1 Assessment and management

It is recommended that patients are treated by the same SLT post-operatively to ensure the detection of new, discrete communication changes and consistency of care.

There are several factors which can impact a patient's performance in the immediate days following surgery, e.g. fatigue, persisting effects of anaesthesia, brain oedema, or post-ictal status (if the patient has seizures intra-operatively).

SLTs should offer a post-operative assessment to diagnose new language deficits (if present) and compare with pre-operative performance. SLTs can offer education and reassurance to patients and their family/friends; and provide communication support, advice and bespoke therapeutic interventions, as needed. Studies have shown that severe deficits in the immediate phase following surgery, will typically improve or resolve in the 6-month post-operative period (Shanai et al 2008., Leon-Rojas et al 2020).

7.4.2 Patient advocacy

In cases where patients have language changes, the SLT role is dynamic and tailored to the needs of the individual. As well as providing targeted impairment-based therapy, SLTs have a key role in supporting patient participation in the following areas:

- mental capacity assessments (for further information please see the RCSLT guidance on supporting decision making and mental capacity)
- diagnosis meetings
- discharge meetings
- medical meetings pertaining to treatment

SLTs can support patient understanding of information and explore alternative and augmentative methods of communication (AAC). Please see the RCSLT guidance on AAC for further information.

7.4.3 Optimisation for hospital discharge

SLTs should be aware of the outcome of histopathology findings from brain biopsy tissue, specifically in relation to diagnosis, treatment pathway and prognostication. Collaborative working with the MDT is imperative to ensuring safe discharge from hospital to appropriate rehabilitation or home setting. SLTs, alongside OT, PT and neuropsychology, will identify patients who require further inpatient, outpatient or community-based follow up. Onward referrals should be made in a timely manner, as well as signposting patients to other supportive bodies, such as the Brain Tumour Charity.

8. Multilingual patients

8.1 Neural language organisation of multilingual individuals

Worldwide, multilingual people are the rule rather than the exception. However, the monolingual brain and language processing system are still considered the norm in neurocognitive models of language and clinical practice. This can make brain mapping and intra-operative language assessment for multilingual patients challenging and heterogeneous.

A 2023 systematic review highlighted factors such as age of acquisition (less than 7 years), language proficiency, language exposure and similarity to other learned languages may play a role in the cortical organisation of language. For example, those languages acquired later in life may have a less predictable pattern to cortical organisation (Pascual et al). This highlights the need for person-centred and bespoke care.

8.2 Considerations for multilingual mapping

SLTs should ascertain what language(s) a patient speaks as early as possible. Whilst the goal is to ensure each language is mapped and preserved intra-operatively, the following factors should be considered when determining suitability for multilingual brain mapping, and prioritisation of languages:

- language proficiency
- age of acquisition
- primary language(s) used across settings (educational, professional, familial, social)
- modality of use (spoken, signed, written, reading)
- dialect and availability of a qualified interpreter
- the patient's goals for language preservation and perceived implications for quality-of-life.

SLTs should be aware of the potential risks with multilingual mapping in awake craniotomy. For example, the more languages which are being tested during the mapping process, the more stimulation the cortex will receive and the longer overall length of surgery. There is a possible correlation between cortical mapping and the induction of seizures, therefore prioritisation of languages may be warranted if a patient speaks multiple languages (ReFaey et al 2020). Similarly, the more languages that are tested, the longer the overall time of surgery. This may have implications on patient levels of fatigue and overall performance during language monitoring within the resection phase, or during language mapping of sub-cortical areas which typically occur further into the surgery timeframe.

Following a comprehensive review of the patient's linguistic profiles and understanding of patient priorities, the SLT is well placed to support MDT discussions on the risks and benefits of multilingual mapping and discuss mapping protocols with the neurosurgeon.

8.3 Cultural considerations

Currently, there is no standardised approach for assessment for multilingual patients undergoing an awake craniotomy. Challenges of bias may occur relating to the socio-cultural background of multilingual patients, the use of culturally inappropriate testing materials (with a monolingual ethnical/linguistic normative group), and unpredictable biases depending on the unique characteristics of the individual, such as the number, type and combination of spoken languages (De Martino et al 2021).

SLTs working with multilingual or non-English speaking patients should reference the RCSLT bilingualism guidance and align practice with the gold standard principles laid out.

8.4 The use of interpreters

Qualified interpreters should be sought to ensure a high-quality translation of the patient's spoken and/or written output. SLTs have a key role in preparing and training the interpreter for their nuanced role in surgery. It is strongly recommended that the same interpreter is used at the pre-operative, intra-operative, and ideally, post-operative stages. This will support with rapport building with the patient, establish a working relationship with the SLT, enable the interpreter to make quick judgements of a linguistic change and relay these in a timely manner to the SLT and neurosurgeon.

If qualified to do so, an interpreter can also support with the translation of written materials to ensure these are culturally and linguistically appropriate.

Clinicians who work with interpreters should read the RCSLT interpreters guidance.

8.5 Multilingual testing

The process of pre-, intra- and post-operative language testing for multilingual patients should mirror that of the process for monolingual patients. Where possible, the use of standardised and validated intra-operative language assessment should be utilised. However, access to such resources can be limited. As a compromise, DeMartino et al (2021), found informal testing and translating testing materials are frequently used within clinical settings.

Mariotti et al's 2025 UK based survey of clinical practice in multilingual mapping highlighted variable practice in the pre and intra-operative language testing. Objective (picture naming) and subjective measures (patient or family reports) were obtained pre-operatively. Language switching – the ability to alternate between languages – was used by 46%, 18.2% and 16.2% of responders in the pre, intra and post operative assessments, respectively. They argue the urgent need for guidelines and tasks to ensure the effective preservation of bilingual skills in awake craniotomy patients.

In the absence of an established testing paradigm for multilingual patients, SLTs should use their clinical experience and skills to tailor testing paradigms to fit the needs and background of the patient. They should refer to the evidence base and align test selection with current language network systems.

9. SLT training and competence

9.1 Core skills and knowledge

SLTs who work in awake craniotomy should, as a minimum, demonstrate the following:

Clinical expertise and experience:

- Extensive experience working in adult neurology
- Extensive experience in selecting, conducting and interpreting language assessments, including in patients with additional languages
- Advanced knowledge of eloquent cortical and subcortical language pathways
- Advanced knowledge of intra-operative language frameworks and assessment methods, including the supporting research and literature
- Extensive experience in diagnosing and characterising aphasia
- Extensive experience in offering therapeutic interventions in aphasia
- Experience working with interpreters
- Knowledge of low-grade and high-grade brain tumours, including prognosis and disease trajectory
- Understanding of neuro-oncology processes and pathways, both within the local service and across wider cancer networks (e.g., Tessa Jowell Brain Cancer Mission)
- Counselling skills and experience in supporting behavioural change (see RCSLT counselling guidance)
- Ability to prepare and support patients and families throughout the awake craniotomy pathway

Theatre and surgical context knowledge:

- Knowledge of anaesthetic approaches and their potential benefits/risks
- Knowledge of functional neuroimaging techniques (e.g., DTI, nTMS, fMRI, MRI) and their relevance to pre-operative cortical and white matter tract mapping
- Understanding of the multidisciplinary team roles within awake craniotomy and neuro-oncology services
- Awareness of infection prevention and control procedures and completion of local theatre induction
- Ability to communicate confidently and assertively in the theatre environment
- Awareness of relevant local and national policies and guidelines

9.2 Acquisition of knowledge and skills

Knowledge and skills can be developed through a range of activities, including:

- Reviewing the current evidence base and relevant literature
- Completing online tutorials (e.g., FutureLearn: Awake Brain Surgery)
- Undertaking clinical observations
- Accessing online educational platforms, such as the RCSLT Awake Craniotomy member resources page [link to be added] and the Tessa Jowell Academy
- Engaging in peer supervision
- Engaging with RCSLT awake craniotomy advisors
- Participating in professional supervision and mentoring
- Attending relevant conferences and educational/networking platforms

9.3 Supervision

Given the specialist and emerging role of SLTs in awake craniotomy, access to an appropriately trained supervisor within individual institutions may vary. Clinicians are expected to be proactive in seeking appropriate professional supervision and employers should allow support and time for this. Examples may include negotiated external supervisors, accessing peer supervision and/or ensuring links with RCSLT advisors. For further information, please see RCSLT supervision guidance.

Clinicians are encouraged to enrol with the Tessa Jowel Academy, which offer SLTs e-networking opportunities, as well as courses and seminars to support clinicians continued professional development in both neuro-oncology and awake craniotomy.

10. Future directions

10.1 Research and innovation

Current research on the role of speech and language therapists in awake craniotomy remains limited. A stronger evidence base is needed to support and promote SLTs' involvement in these services. The literature relating to intra-operative language testing is inconsistent, with no consensus on the most appropriate assessment tools. As a result, SLT practice in awake craniotomy varies considerably (Mariotti et al., 2025). The SLT workforce is well positioned to contribute to the development of robust evidence, thereby enhancing the quality of care delivered to patients.

Future research and innovation should prioritise achieving agreement on standardised intra-operative language resources, considering the needs of multilingual patients. Such consensus would support more streamlined, consistent practice across the UK and help ensure optimal patient outcomes.

There is also growing interest in the integration of emerging technologies—such as artificial intelligence and virtual reality—into awake craniotomy procedures (Bernard et al., 2023). SLTs should collaborate closely with MDT colleagues, and where appropriate take a leading role, in implementing these innovations. Regular audits, service evaluations, and quality improvement initiatives are essential to drive progress in this field.

Ongoing workforce upskilling is essential. The development of a competence framework may provide a valuable mechanism for promoting consistent, high standards of practice across the profession.

10.2 Influencing and campaigning

Continued promotion and integration of the SLT workforce in awake craniotomy services is needed. SLTs are encouraged to actively advocate for the profession's specialist role in awake craniotomy at local, national, and international levels. Engagement in influencing and campaigning efforts is essential to secure appropriate service funding and recognition.

SLTs should reference the RCSLT website for resources in delivering quality services (e.g. sections on service planning and improvement and local influencing).

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